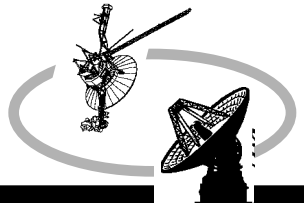


DSS-13 W-band Assessment

- **Extended capability and optimized performance of radio astronomy W-band receiver staged at DSS-13**
  - **Implemented computer-controlled aperture load and load temperature readout for calibrated, total power, radiometric measurements**
  - **Developed phase-lock for first local oscillator stage (75 GHz) in the laboratory**
    - **Once implemented and verified at the telescope, DSS-13 will be W-band VLBI-ready**
  - **Optimized W-band package z-axis alignment by measuring focus curves**
  - **Optimized noise temperature contribution of LNAs by bias adjustment of first and second amplifier stages to achieve design goal of T_{RCVR} = 65 K**
  - **Estimated contributions from the atmosphere and the antenna to zenith system temperature from tip curve and receiver temperature measurements:**

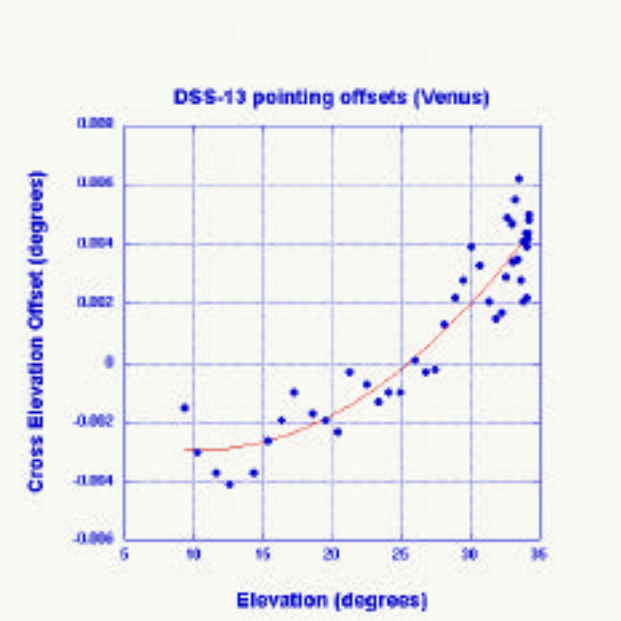
$$T_{RCVR} = 65\ K$$
$$T_{ATMOS} = 16\ K$$
$$T_{ANTENNA} = 40K$$

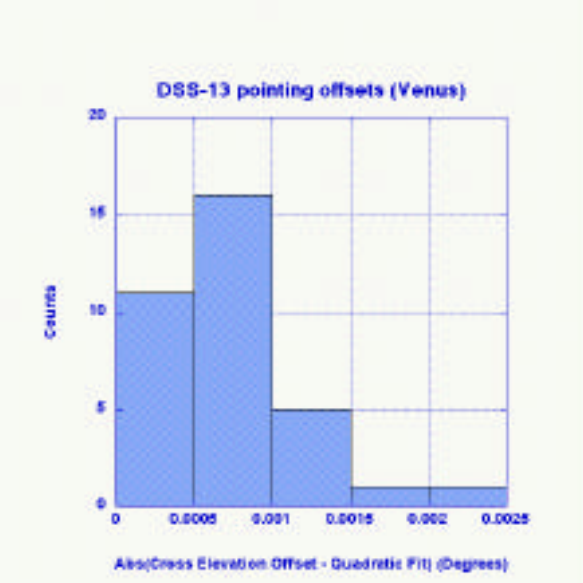
$$T_{SYS} = T_{RCVR} + T_{ATMOS} + T_{ANTENNA} = 121\ K$$

M. Seiffert, L. Skjerve, L. Tanida

DSS-13 W-band Assessment

- **Estimated preliminary blind-pointing capability**



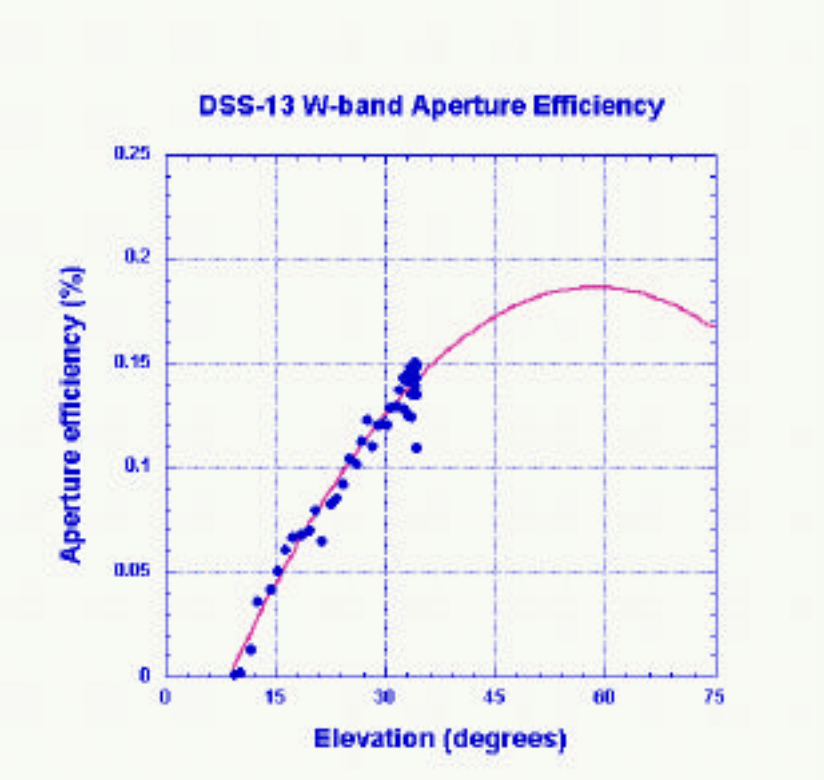


  - **Heuristic quadratic fit - “poor man’s” systematic error model**
  - **Residuals about fit < 2 mdeg**
  - **Repeatability needs to be verified**
  - **Result should improve with respect to real systematic error model**

D. Jones

DSS-13 W-band Assessment

- **Measured preliminary aperture efficiency**



- **Measured efficiency still increasing with elevation angle**
- **Peak efficiency still to be determined**
- **Expected symmetry, rolloff about rigging angle, still to be determined**
- **Extrapolation from curve fit suggests**

Peak aperture efficiency = 18%

DSS-13 W-band Assessment

- **Developed design control table - predicted performance with current surface figures:**

Element	Label	Efficiency(%)	Mirror RMS(Inches)
Main reflector	a	0.4183	0.0102
Subreflector	b	0.8110	0.050
Feed Support Blockage	c	0.8746	Quadripod

E1 = primary surface contribution = a x b x c = 0.2967

Mirror 1, BWG	d	0.9529	0.0024
Mirror 2, SOLID	e	0.9670	0.0020
Mirror 3, BWG	f	0.9274	0.0030
Mirror 4, SOLID	g	0.9732	0.0018

E2 = intermediate mirror contribution = d x e x f x g = 0.8317

Mirror 5, BWG(Ellipsoid)	h	0.9274	0.0030
Mirror 6, SOLID	i	0.9274	0.0030

E3 = pedestal mirror contribution = h x i = 0.8601

Feed efficiency at F3		
Non-diplexed I^2R Loss	j	0.9600
Path 1 VSWR	k	0.9900

E4 = microwave subsystem contribution = j x k = 0.9504

Predicted aperture efficiency at F3 = E1 x E2 x E3 x E4 = .2017 ~ 20%

- **To be a world-class W-band antenna for VLBI, the DSN operational BWG subnet would need to achieve an aperture efficiency of 35%. Surface figures that would meet that goal:**

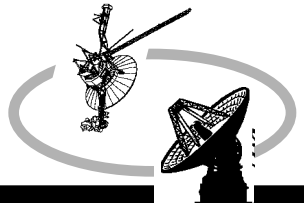
E1 = .4455 = 0.55 x 0.90 x 0.90 = main x subreflector x support blockage

E2 = .9224 = (.98)^4, four reflecting surfaces

E3 = .9025 = (.95)^2, two reflecting surfaces

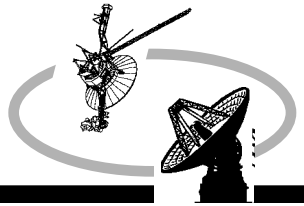
E4 = .9801 = (.99)^2, two elements

Aperture efficiency achieved at F3 = E1 x E2 x E3 x E4 = 0.3635



DSS-13 W-band Assessment

- **Receiver Development**
  - ●●● **Phase-lock receiver first LO stage**
    - **Implemented and tested in the laboratory, to be verified at DSS-13 (Q3)**
  - ●●● **Implement calibration capability utilizing an ambient load and noise diode**
    - **Load implemented and routinely operational**
    - **Noise diode approach still TBD and to be implemented (Q3)**
  - ✓ **Optimize noise temperature contribution of LNAs by bias adjustment**
- **Pointing and Efficiency**
  - ✓ **Measure aperture efficiency**
  - ●●● **Assess antenna blind-pointing performance using point sources**
    - **Initial measurements with planetary targets; point source detections next (Q3)**
  - \+ **Developed initial design control table**
- ●●● **Telecommunications link margin study**
  - **Slipped due to short-term workforce prioritization - putting out fires (Q3)**



DSS-13 W-band Assessment

- **Receiver Development**
  - **Complete phase stabilization of the W-band receiver**
  - **Implement W-band appropriate, computer-controlled, noise injection technique to complete radiometric calibration capability**
- **Pointing and Efficiency**
  - **Measure aperture efficiency as a function of azimuth and elevation**
  - **Determine systematic error model based on point source observations**
  - **Assess blind-pointing performance with respect to systematic error model**
  - **Study the repeatability of 2 mdeg pointing precision**
  - **Apply raster scan technique at DSS-13 and obtain preliminary results at X- and Ku-bands**
  - **Assess capability of DSS-13 antenna servo system to support precise W-band tracking**
- **Telecommunications**
  - **Perform updated W-band link margin study**